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anterior two or three and the last, affords insertion to four groups of short bristles, to which muscles are attached, and by means of which the worm progresses. The bristles may be made to point in either direction, according as the worm wishes to advance or retreat. When pointed toward the tail, they hold the worm as it crawls ahead; when directed ahead, they give foothold for retrograde movement.

Now a person would suppose that the presence of several hundred little bristles, all pointing the 'wrong way,' would interfere with easy and pleasurable deglutition; and inasmuch as a worm, normally, crawls ahead, and not back, I expected to see my Thrush swallow worms head first, when, it is to be presumed, the bristles in question would not retard the process. As a matter of fact the contrary method, as noted above, was followed. Once in a while, a small worm was seized by the middle and doubled, or taken by the head; but careful observation, extending over several days, brought out so few instances of this kind that I am convinced it was a rule with the bird to swallow earthworms tail first. The fact that the worm often made some progress in its attempt to escape from the bird's mouth would indicate that the bristles were in working order, despite rough treatment, and that they were pointed back, toward the tail of the worm. From this we must infer, either that the bird was indifferent to the rasping of the bristles on the walls of its throat, or that the sharp resistance they exhibited added spice and flavor to the writhing morsel. But, for all that, any explanation is merely conjecture, and why the Hermit Thrush should choose to begin its meal with the tail of its victim remains a curious, though not a profound, subject for speculation.

RECENT INVESTIGATIONS OF THE FOOD OF EUROPEAN BIRDS.

BY F. E. L. BEAL.

A PAPER upon the food of the Rook (*Corvus frugilegus*) by Dr. Hollrung, appears in the Seventh Annual Report of the Experi-

ment Station at Halle.¹ Another paper by Mr. John Gilmour² of Fifeshire, Scotland, treats of the food of the Rook, the Wood Pigeon (*Columba palumbus*) and the Starling (*Sturnus vulgaris*). These two papers are interesting contributions to the literature concerning the food of three rather important birds, but they can only be considered as giving glimpses of a field in which much remains to be done.

Dr. Hollrung gives the following statement of the food found in 131 stomachs of Rooks killed in April, May and June, within a narrow limit of territory: Larvae of *Zabrus gibbus*, 48; wire worms (Elaterid larvæ), 20; grub worms, 253; May beetles, 160; weevils (*Otiorynchus*), 1688; weevils (*Tanymecus*), 22; snails; mice, 17; grains of wheat, 420; grains of barley, 471; grains of oats, 190; cherries, 22.

From these examinations Dr. Hollrung has arrived at the following general conclusions:

"1. The Rooks examined have proved on the whole neither exclusively useful nor exclusively injurious. While 25 per cent of the Rooks' stomachs contained no vegetable matter, there were only two cases in 131 where no animal matter was found.

"2. Their food consisted for the most part (about 66 per cent) of animal matter, such as mice, larvæ of the grain-eating Carabid (*Zabrus gibbus*), grub worms (*Melolontha vulgaris*), dung beetles (*Aphodius spec.*), and clover weevils (*Otiorynchus ligustici*). The vegetable food was made up of wheat, oats, and barley, and cherries.

"3. The harm done by the Rooks on the one hand was perfectly balanced, and even considerably outweighed on the other hand by the useful services rendered.

"4. The Rooks feed principally on slowly moving insects."

In the investigations made by Mr. Gilmour the stomachs of 336 birds were examined, not counting 19 that were empty. They

¹ Untersuchungen über den Mageninhalt der Saatkrähe (*Corvus frugilegus* L.) Dr. M. Hollrung. 7ter Jahresbericht Versuchs-station f. Pflanzenschutz zu Halle a. S. 1895, pp. 5-26.

² An inquiry Concerning the Relations of Certain Birds to the Agricultural Interest, as shown by their Diet. John Gilmour. Trans. Highland and Agri. Soc. Scotland, 1896. Fifth Series, Vol. VIII, pp. 21-113.

were evenly distributed through the twelve months of the year, but were all killed in a restricted area. Mr. Gilmour thinks, however, that the results obtained would not differ greatly if they had been collected over a larger district, as the one in question may be considered as fairly typical of southern Scotland.

The food found in the 336 stomachs was classified under four heads, viz: (1) insects and grubs, (2) roots, (3) cereal grains and husks, (4) miscellaneous. Of these the third is of the greatest importance, both from its economic interest and from the fact that it is the food most often taken. Mr. Gilmour reckons his percentages from the number of times that the bird has taken the food, and from this concludes that grain and husks constitute 58 per cent of the Rook's food. Insects and grubs, reckoned in the same way, amount to 23 per cent. It can hardly be claimed that this is the most accurate method of calculating the relative amounts of food found in a bird's stomach. Birds are fond of eating a great many different things, the aggregate quantity of which may be small, just as human beings eat a little butter and sugar at nearly every meal, but never make a whole dinner of either. To illustrate, in an examination of 2258 stomachs of the Crow Blackbird corn amounted to 35 per cent of the food by bulk, but when reckoned by the number of times taken it aggregated 52 per cent.

Insects and grubs are mostly eaten by the Rook from May to August inclusive, but only in June and July do they amount to more than any other item. As most of the insects are said to be useful species, Mr. Gilmour is of the opinion that the harm done by their destruction "can scarcely be considered as counter-balanced by the grub consumpt." On the whole, his verdict is against the Rook, for he says: "Taken altogether, the Rook has almost no claim to agricultural regard. . . . Is not the broad fact clear that grain is the staple of staple foods for Rooks? Lusting for it as these birds do, we may rest assured that the Rook will attack and prey freely upon the farmer's grain whenever and wherever favourable opportunity is presented; whether soft or hard, whether sprouted or unsprouted, whether ripe or unripe, whether in dung or on stubble-field, is of little moment to the Rook." While he acknowledges that much of this grain was taken

from dung, or consisted of scattered kernels picked up in stubble-fields, he still considers that it must all be counted against the birds, as it shows their taste for grain. This is not fair. Grain so obtained has no value to the farmer and should not be reckoned as a loss. As a matter of fact, Mr. Gilmour's own tables show that the Rooks *do not* "attack and prey freely upon the farmer's grain whenever and wherever favourable opportunity is presented." Many stomachs taken in harvest time show no grain, and a large proportion of them contained some insects. It cannot be claimed that any of them lacked opportunity to eat grain, for all were collected practically from the same locality.

In comparing the results obtained by these investigators some important differences are noted, and it is seen that the two have drawn almost diametrically opposite conclusions. The Rooks examined by Dr. Hollrung contained 17 mice, an article of food which Mr. Gilmour does not seem to have found in his. The insects, unlike those eaten by the Scottish Rooks, were mostly noxious species whose destruction was a decided benefit to the farmer. While grain was eaten to some extent by Dr. Hollrung's Rooks, it does not appear to constitute an important article of their diet economically considered.

Mr. Gilmour assumes that the Rooks taken in Fifeshire fairly represent those of the whole of the Lowlands of Scotland in their food habits, an assumption that may possibly be true, but Dr. Hollrung's investigation shows that no such supposition will hold for extensive areas of country. Stomach examination as well as field observation shows more and more that the kind of food taken by birds is determined by availability as well as taste; consequently the food of any particular species will vary to a certain extent in different localities.

The Common Crow (*Corvus americanus*) represents in this country, as nearly as may be, the economic position occupied by the Rook in Europe, and a few points of comparison in their food may not be without interest. The food of the Crow consists of about the same proportion of animal and vegetable matter as that of the Rook.

In the first four items of Dr. Hollrung's list the Crow and the Rook present a great similarity of taste, the *Lachnosteria* of this

country replacing the *Melolontha* of Europe. It is in the next two items, the weevils, that the Rook shines resplendent. An average of over thirteen specimens of those small but very harmful beetles in each of the 131 stomachs is certainly a splendid showing. It is singular that none of these insects were eaten by the Rooks taken in Scotland. While many of these beetles were eaten by the Crow, they do not constitute so constant and important an item as in the case of the Rook. The Crow eats a considerable number of Carabid beetles, most of which are of the more predaceous species, while those eaten by the Rook are, for the chief part, the larvæ of *Zabrus gibbus*, a very destructive grain-eating species. Grasshoppers, which are extensively taken by the Crow, are conspicuously absent from the food of the Rook.

In the varieties of vertebrates eaten, the Rook is far behind the Crow. Only seventeen mice were found in the 131 stomachs taken in Germany, and none in those collected in Scotland. In no case did any stomach contain the remains of more than one. The Crow, on the other hand, not only preys upon mice and other small mammals but even captures young rabbits, and eats many snakes, young turtles, salamanders, frogs, toads and fish. The Crow also eats many crayfish and other smaller crustaceans which do not appear in the Rook's bill of fare.

In the matter of vegetable food the Rook does not seem to indulge in any great variety. It does, however, eat some potatoes, which the Crow rarely touches. The Crow eats about every kind of grain that the country produces, besides fruit and acorns or other mast. It appears to be far more omnivorous than the Rook; in fact, it seems doubtful if there is anything eatable which a Crow will not eat, while, so far as shown, the Rook is quite exclusive.

In Mr. Gilmour's investigation of the food of the Wood Pigeon 245 stomachs were examined. They were quite evenly distributed through the year, but, like the Rooks, were all taken within a limited area. The contents of these stomachs are arranged in five groups, which, taken in the order of frequency, are as follows: (1) Cereal grains; (2) leaves; (3) other fruits and seeds; (4) roots; (5) flowers. Cereal grains were taken to the extent of 33 per cent of the year's food, by Mr. Gilmour's method of calcula-

tion, but as a great part of this was eaten in the months after August it would seem to an American farmer that it must be mostly waste grain picked up in the stubble fields. Leaves were eaten to the extent of $27\frac{1}{2}$ per cent and a large amount of these were leaves of clover. While a bird that eats clover leaves may be potentially harmful, it is evident that the birds must be wonderfully abundant in order to do the clover much damage by simply eating the leaves. A great number might possibly hurt the forage by breaking it down and sitting upon it. Besides clover leaves, the Pigeon also eats the leaves of turnip and several weeds, as well as the seeds of beans, peas, clover, turnips, weeds and some trees. Roots and underground stems (mostly potatoes) are eaten to the extent of $8\frac{1}{2}$ per cent. Mr. Gilmour's conclusions are entirely against the Pigeon. He says: "Though grain be left entirely out of court, the Pigeon stands utterly condemned by the heavy black score still standing against him for root-crop and clover-leaf destruction." While we know nothing about this bird practically, we are inclined to think that further observation and thought will serve to render the score several shades lighter.

Of the Starling, 175 stomachs were examined, collected in every month, though but few were taken in July, August, October and December. Like the Rooks and Wood Pigeons, the Starlings were all taken within a small area of country. With regard to the food in these stomachs, Mr. Gilmour says. "... Starlings are most monotonous in regard to diet. All the food-stuffs found in the crops and gizzards examined are conveniently grouped thus: (1) grubs; (2) insects, etc.; (3) cereal grains; (4) miscellaneous."

Of these the first two amount to 70 per cent of the whole food, and the third to 22 per cent. This grain is very properly not reckoned as being very valuable, as the tables show that most of it was taken after harvest time, so that the comparative usefulness of the bird is made to depend upon the character of the insect food. Mr. Gilmour does not seem to have any very definite method of determining comparative quantities of food, for he says: "The *how much* of each kind cannot, of course, be stated; but the impression which one gets from careful and close examination of the contents of any large batch of Starlings is that the

injurious species are more frequent in the birds than the useful kinds." It is gratifying to learn this, as the Starling has been introduced into America, and in time may possibly become numerous enough to be of economic importance.

Mr. Gilmour makes the following happy summation of the status of the three birds whose food habits he has investigated. "Of the Pigeon it may be said that he is an unmitigated scoundrel; of the Rook that he is a cunning rogue; but of the Starling we can say with truth that he is our natural friend, by habit and by instinct."

SOME NOTES ON THE NESTING HABITS OF THE WHITE-TAILED KITE.

BY CHESTER BARLOW.

THE White-tailed Kite (*Elanus leucurus*) is perhaps as common in certain portions of California as anywhere throughout its breeding range, and it is resident in Santa Clara County, where the genial climate and almost perennial sunshine are conducive to an abundant food supply. Santa Clara County lies south of the San Francisco Bay region, and its northern boundary is the lower shore of San Francisco Bay. The northern portion of the county consists of the 'lowlands,' which support, in many places, a luxuriant growth of willow. Toward the ranges which surround the valley there are magnificent fields of live oaks and white oaks, which have attained in many places a grand perfection. Considerable of this country is given to farming, and here the trees have been spared. Approaching the foot-hills, and all through the valley from San Jose southward, especially along the water courses, the sycamore and white oak are most commonly met with, and afford the *Buteo* tribe many available and secure nesting sites. Thus it will be seen that certain portions of Santa Clara County are peculiarly attractive to raptorial birds as breed-